

CHAPTER 6: MEASURES AND MONITORING FOR GAUGING PROGRESS

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The WRIA 8 Steering Committee strongly endorsed measuring Chinook and habitat health at the watershed level as a foundational element of this plan to:

- 1) Gauge progress toward recovering salmon populations and restoring habitat,
- 2) Assure money is spent on actions that truly make a difference,
- 3) Evaluate resources for meeting interim improvement goals, and
- 4) Document progress, showing when de-listing criteria have been met.

All information should be collected, analyzed, and reported specifically to support the Oversight Committee and Summit Advisory Body in their decision-making processes. (See Chapter 2, which recommends that future decisions about action priorities and resources be accomplished by two separate policy bodies: the Oversight Committee and Summit Advisory Body). Projects should be audited for performance, to improve designs and assure that expected outcomes are being achieved. The monitoring information should also be summarized in plain language and used as a report card to the public for documenting progress and showing how well limited funds are being used.

Monitoring, tightly linked to decision-making, is an essential element for the success of the Plan. It is only through monitoring data that federal agencies will be able to come to a de-listing decision. However, the region has never before engaged in this level of monitoring and decision-making. Funding for this component of the plan is currently uncertain. Strong leadership will be required at both policy and technical levels to implement this foundational element of adaptive management.

The WRIA 8 Steering Committee has not yet finished the monitoring and adaptive management work plan. It is anticipated that in 2005-2006, the Steering Committee/Oversight Committee will be working with the Technical Committee, as well as state and regional efforts, to establish specific, hypothesis-based monitoring plans.

Monitoring plans should be linked to the expected outcomes from recovery actions. As a result, decision-makers should be able to easily evaluate whether efforts are directed at the most effective places and whether improvements in habitat and Chinook health are meeting watershed expectations. These evaluations should directly link to future actions and level of effort.

Why do we need monitoring?

“Monitoring” is commonly considered an “extra” or unnecessary expense. This is often because the information is not generated to provide specific information to inform decisions based on management questions or hypothesis testing, nor collected and analyzed in a timely manner for use by decision-makers. In fact, monitoring is a basic need when working on complex problems, like salmon conservation, where there are limited resources and a high degree of accountability, but where uncertainty remains either in terms of a basic understanding of conditions present or in terms of the effectiveness of proposed or implemented actions. Linking monitoring to actions of highest importance or related to greatest uncertainty provides decision-makers with data that can 1) help provide certainty that money is spent on the most critical actions, 2) show that the actions are achieving objectives, and 3) describe progress towards goals. The monitoring framework described in the following text, in combination with the reporting and evaluation process described in Chapter 2 is intended to ensure that information

collection informs and is driven by anticipated decisions regarding priorities and resource allocation.

This monitoring framework generally follows the definitions of monitoring as described in the “Statewide Strategy to Recovery Salmon” (Washington State Joint Natural Resources Cabinet, September 21, 1999). These include:

- 1) Implementation Monitoring: Are actions being implemented as planned?
- 2) Direct Effectiveness Monitoring: Are actions having the anticipated outcomes?
- 3) Cumulative Effectiveness Monitoring: Is the sum of all actions within a basin or across the watershed improving habitat and salmon population conditions?
- 4) Validation Monitoring: Are Chinook salmon populations increasing in productivity, abundance, distribution, and diversity? What are the cause and effect relationships between actions and fish population changes?

Information gathered in a systematic and meaningful manner provides the basis for showing progress toward achieving Plan goals through the implementation of actions. There are different types of monitoring that can help show progress and support future decisions that will ensure additional progress.

1) **Documenting which actions were implemented and which were not** will allow decision-makers to know who, what, how, how much, and where actions have been taken and whether those are representative of the plan strategy and to know where additional funding, clarification, or other work is needed to completely implement the Plan.

2) **Evaluating the success of projects in meeting specific objectives** will allow application of information from individual projects to general types of projects. Further, this will help decision-makers know the types of actions that produce results and allows decision-makers to reduce the funding towards projects that do not produce good results.

3) **Monitoring changes in habitat and in survival of various life stages of Chinook** will allow regional decision-makers to make adjustments to improve the effectiveness of specific types of actions. It will reduce the risk of funding unsuccessful projects. Ultimately, it will allow decision-makers to evaluate the success of the Plan actions in restoring healthy ecosystems and Chinook populations. Monitoring the status and trends of watershed conditions and aquatic habitat in a randomized approach will allow a subset of the watershed to represent trends in the overall health of the watershed. This will require less funding than monitoring the same factors in more places around the watershed in a less systematic or strategic manner.

Who else is working on monitoring?

The WRIA currently does not fund a comprehensive monitoring program. The WRIA has partially funded, through grants, some of the Chinook spawning and juvenile studies. The majority of the technical data used in the Plan has been generated through individual jurisdictions, and state and federal agencies. The graph shown below provides a general illustration of the relative contributions from some of the individual monitoring programs for cumulative effectiveness monitoring. This graph does not incorporate all the individual data sources and costs, but illustrates a sampling of available Chinook and habitat cumulative monitoring costs by local jurisdictions and agencies for data commonly used in the planning process. This graph includes local costs for juvenile Chinook monitoring, spawner surveys,

migration studies, multi-spectral analyses, new flow gauging, and some habitat assessments. Additional information about the types of local monitoring programs incorporated into this graph is provided below and in Table 6-1.

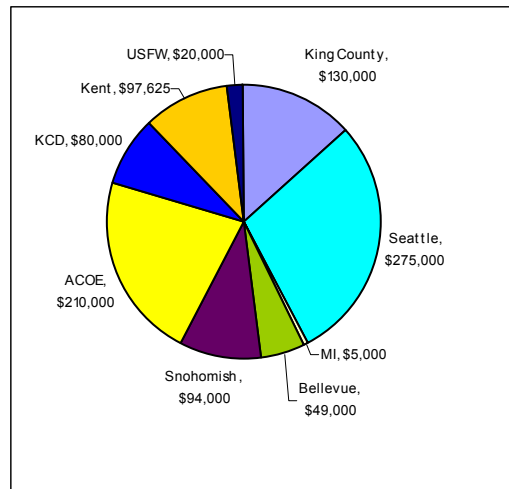


Figure 6- 1 Sample of Local Cumulative Monitoring Costs Used in WRIA Plan

Individual Entities - WRIA 8 Monitoring and Research

Local monitoring programs conducted by individual entities in WRIA 8 focusing on salmon populations, habitat utilization, predation pressures, food web interactions, thermal migration barriers, lakeshore habitat utilization by juvenile Chinook, juvenile migration timing, and other biological and ecological processes have been invaluable in developing the scientific strategy for WRIA 8. These programs include the City of Seattle monitoring programs for the Upper Cedar Habitat Conservation Plan (HCP) and shoreline studies; the Army Corp of Engineers General Investigations for the Lake Washington Watershed and Ballard Locks studies; the State Department of Fish and Wildlife and locally sponsored Sockeye Studies; NOAA Fisheries, USGS, and Seattle coho prespawn mortality investigations; Snohomish County ambient water quality and benthic invertebrate (BIBI) monitoring, habitat survey, stream gauging, and salmon watchers programs as well as the natural and built drainage inventory program, fish passage barrier inventory and assessment program and land cover classification (1991 and 2001) for all of WRIA 8, and King County Chinook and habitat monitoring programs through the Wastewater and Natural Resources programs. The Cities of Seattle and Bellevue conduct weekly spawner surveys in the urban streams. These surveys augment information from the co-managers and regional efforts in the core spawning areas, the Cedar River, Issaquah Creek, and Bear/Cottage Lake Creek along with other North Lake Washington tributaries. Other local programs, such as flow gauging and habitat assessment work, being conducted by the City of Kent for their Rock Creek HCP, was incorporated into the technical reach assessments for the Ecosystem Diagnosis and Treatment (EDT) model and Chinook distribution mapping.

These local monitoring programs have provided foundational data for the Plan. However, the current funding source for these programs is based on the individual entity's project or program needs and continued funding is uncertain beyond 2004-2005. The Steering Committee strongly endorses the continuation and financial support of smolt traps, spawner surveys, PIT tags, snorkel surveys, and salmonid migration studies. The proposed Oversight Body will need to work with local, state, and federal entities to identify partnerships and assist agencies to

obtain funding for continuation or enhancement of existing critical monitoring programs (Table 6-1).

Regional and State Monitoring Efforts

Many factors (harvest, hatcheries, habitat, hydropower, and ocean conditions) influence Chinook salmon population characteristics (diversity, abundance, productivity, and distribution). However, the WRIA 8 plan is focused on protecting and restoring freshwater and nearshore marine habitats. Since the desired outcome is healthy, harvestable Chinook populations rather than merely improving aquatic habitat, WRIA 8 efforts to monitor habitat and Chinook survival improvements will need to be linked with monitoring the effects of other actions at the state and federal level, e.g., harvest and hatchery management, to restore Chinook populations.

There have been a number of efforts to improve monitoring efforts at the regional and state levels. It will require staff and policy level discussions to determine who should take the lead and fund various elements that are common to multiple groups. Some of these efforts with potential overlap or coordination opportunities with WRIA 8 have been summarized below.

Validation Monitoring Panel - Chinook population monitoring recommendations

The Validation Monitoring Panel, assembled by the Olympic Natural Resources Center of the University of Washington, conducted an interdisciplinary review of the various scientific issues and problems associated with monitoring Chinook salmon populations. The international panel of recognized scientific leaders reviewed various approaches to monitoring salmon populations. The focus of this effort was to evaluate the statistical design of programs monitoring genetics of salmon populations, fish productivity, and habitat requirements at various spatial and temporal scales. The panel provided recommendations for a consistent scientific framework for validation monitoring for salmon conservation efforts to federal, state, and tribal governments in the Pacific Northwest (College of Forest Resources, University of Washington. December 1, 2000). These recommendations and considerations should be followed by WRIA 8 when conducting validation monitoring for Chinook population response to be sure the information collected can be utilized at various spatial scales.

Washington State Monitoring Strategy

At the direction of the Washington State Legislature in 2001 (SSB 5637), the Governor's Salmon Recovery Team led an interjurisdictional effort to improve State monitoring efforts to develop a comprehensive monitoring strategy to evaluate the success of salmon and habitat recovery actions. Reports, including "The Comprehensive Monitoring Strategy and Action Plan," are available at <http://www.governor.wa.gov/gsro/monitoring.htm>. The State is starting to implement the recommendations for monitoring the effectiveness of Salmon Recovery Funding Board (SRFB) projects this year. The State has not yet implemented a program for intensively monitoring one or more watersheds for evaluating the influence of specific habitat improvements on fish population parameters. The recommendation for using an Environmental Protection Agency (EPA) Environmental Monitoring and Assessment Program (EMAP, <http://www.epa.gov/emap/>) randomized sampling protocol for tracking the status and trends of watershed health at a WRIA level has also not yet been implemented. WRIA 8 monitoring efforts should utilize the protocols recommended by the State Monitoring Oversight Committee, coordinate with the SRFB project monitoring efforts where possible, and use the EPA EMAP protocols for evaluating the status and trends in watershed condition. The proposed WRIA 8 Oversight Body should approach the Governor's Salmon Team and SRFB to incorporate WRIA 8 into the State program.

Co-managers Monitoring Program

The Washington State Department of Fish and Wildlife, the Muckleshoot Tribe, and the Suquamish Tribe, as the state co-managers of fisheries resources in WRIA 8, conduct a variety of monitoring programs in the watershed (<http://www.nwifc.wa.gov/sshiap2/index.asp>). These programs include, but are not limited to, weekly salmon spawning index surveys in the Cedar River, Issaquah Creek, and Bear/Cottage Creek, adipose clipping and coded wire tagging (CWT) programs to evaluate harvest impacts and straying of hatchery fish, genetic sampling of Bear/Cottage Creek for genetic impacts from hatchery strays, adult salmon counts at the Ballard Locks, fish pathology monitoring of hatchery fish and waters, and scale analysis for aging spawning salmon. Many of these monitoring efforts are already coordinated with local efforts; some of the monitoring is even augmented with local and WRIA funds. The Steering Committee recommends the existing programs be continued and increased to complete entire spawning periods for all salmon populations within the watershed. The State has identified additional monitoring recommendations for WRIA 8 based on the Hatchery Scientific Review Group recommendations (HSRG 2004). These research and monitoring recommendations have not yet been discussed or approved by the co-managers, but are consistent with WRIA 8 recommendations.

Puget Sound Ambient Monitoring Program (PSAMP)

The Puget Sound Action Team (PSAT) coordinates monitoring efforts by federal, state, and local agencies through the Puget Sound Ambient Monitoring Program (PSAMP) to assess the trends in the environmental health of Puget Sound and evaluate the success of the Puget Sound Management Plan (<http://www.psat.wa.gov/Programs/PSAMP.htm>). The PSAT also provides staff support for the Nearshore Policy Group, which is identifying hypotheses and recovery recommendations for the Puget Sound nearshore and marine waters for the Shared Strategy for Puget Sound. The Steering Committee recommends coordinating and augmenting efforts through the PSAMP program for evaluating the status and trends for WRIA 8 marine areas.

Coordination Requirements

The monitoring programs described above have been established for specific purposes, with the local programs often not related to salmon conservation planning needs. Policy level interaction from the proposed Oversight Body and proposed Executive Director will be needed to encourage those agencies and jurisdictions to join monitoring efforts with WRIA 8. Assistance from the proposed Oversight Body and local jurisdictions may be needed to secure funds for federal or state agencies to maintain their current level of effort and to coordinate with WRIA 8 technical staff. The Technical Committee will need to coordinate and develop scientifically valid protocols for collecting, analyzing, and storing data that can be shared between jurisdictions and agency for use at local, WRIA, or larger scales of interest.

Recommended Parameters and Monitoring Timeframes

Recommendations identified in this section have been identified as important for monitoring plan effectiveness and progress towards salmon recovery. This does not suggest that WRIA 8 jurisdictions implement and fund each recommendation, but it does imply that if WRIA 8 jurisdictions do not implement and fund them some other entity must/should. Additional work at the proposed Oversight Body and Technical Committee levels is needed to establish monitoring responsibilities between local entities and other regional, State, or Federal agencies.

The Steering Committee provided direction to staff as follows:

- Find ways to effectively and efficiently measure progress on habitat conditions and Chinook response

- Find ways to evaluate our efforts for continually improving key actions
- Utilize existing programs or efforts where available – avoid duplication of efforts.
- Utilize results and coordinate with similar monitoring efforts to improve understanding of projects with uncertain outcomes.
- Monitoring methods should be cost-effective. Use what is measured through other means and for other purposes, where possible.
- Evaluate areas of major uncertainty
- Identify endpoints and provide enough information to know when we have achieved our goals
- Information should be used to communicate progress to the public and others
- Monitoring should focus on both habitat and salmon population measures.
- Watershed conditions should be evaluated at the watershed, rather than basin level.
- Direct effectiveness monitoring should be focused on those actions with the most uncertainty or in uncertain environments, which mean higher risk.
- Direct effectiveness measurement of educational outcomes is important.
- Direct effectiveness monitoring of land use actions should be correlated to growth.
- Cumulative effectiveness is the priority monitoring concern. It is important that cumulative monitoring be comprehensive and encompass non-project actions and predation.
- Link direct effectiveness monitoring efforts to cumulative monitoring efforts, if possible.

Implementation Monitoring

It is necessary to understand which actions were implemented, where the actions occurred, and the anticipated outcomes of the actions (e.g., based on the limiting factor treated) to evaluate the success of the Plan. The implementation monitoring program will be developed after the final action elements and goals have been adopted by the Steering Committee and the Forum. Implementation monitoring is anticipated to be a relatively simple checklist summary that would include the type of action, the reach or basin of impact, specific objectives the action was supposed to address, the area treated (i.e., length of stream or streambanks restored, area of riparian vegetation enhanced, or amount of stream or off-channel area made accessible), anticipated benefits of the action, and cost. Implementation information will be essential for establishing effectiveness monitoring, described below. Information will be collected by individual jurisdictions based on common definitions and standard forms. The type of information might include things such as:

Projects: Number of levee setbacks in reach 4 of the Cedar River, length of river affected, area of additional floodplain interaction, and amount of newly created off-channel juvenile Chinook rearing habitat.

Education: Number of lakeshore homeowner programs in Lake Washington, Section 1 (near mouth of Cedar River) on the importance of lakeshore vegetation, number of lakeshore property owners attending, hours of follow-up technical assistance, change in homeowner perspective of native vegetation along shorelines.

Land Use: Number and acreage of good riparian habitat in Reach 3 (Waterways Reach E) of Bear Creek placed into protected status through native growth protection easements or other incentive programs (identified by type) or by acquisition.

The exact parameters will be established by the Technical Committee after ratification of the Plan. Implementation data will be compiled and summarized annually. This information will be communicated with the participating jurisdictions and the public. In the third year after plan ratification, the proposed Oversight Committee will use implementation monitoring information to identify action types that are proceeding well and those action types experiencing barriers to implementation.

Direct Effectiveness

Direct effectiveness monitoring provides the basis for documenting the degree of effectiveness achieved and for improving the design and execution of actions, where needed. Monitoring of actions will also identify unanticipated effects and evaluate whether the actions were achieving the anticipated results. Monitoring plans cannot be developed for direct effectiveness monitoring until the Plan is complete and actions have been firmly slated for implementation. However, monitoring objectives, approaches, and protocols related to monitoring specific project types have been developed by the State, which will allow more rapid progress once implementation of the projects begin. Timelines for direct effectiveness monitoring may vary, but annual reviews of available information will be compiled and shared among the Technical Committee and proposed Oversight/Summit Advisory Bodies. The Technical Committee will have the responsibility for improving the implementation of the projects, while the proposed Oversight Body will have the responsibility for deciding whether specific types of actions should continue to be funded and whether some types of projects or programs should have greater priority over others. Direct and cumulative effectiveness monitoring recommendations are summarized in Table 6-1. This table includes information about the scale of the monitoring effort (reach, basin, and watershed), current funding sources, cost estimates, and opportunities for cooperation with other entities. The cost estimates do not include costs for standardizing protocols, database development, or other data management needs to easily share data between jurisdictions at local, regional, or state levels.

Projects

Once the Plan is ratified and commitments are understood, the Technical Committee will develop a specific 2005 project monitoring plan for evaluating the effectiveness of specific types of projects. Chinook population response will be evaluated through cumulative monitoring efforts, so Chinook response will not necessarily be required for each project. However, in-stream projects that are implemented for specific life stage habitat will likely include monitoring some level of Chinook use of the newly created habitat. The State Salmon Recovery Funding Board (SRFB) has recently implemented direct effectiveness monitoring for State funded projects such as fish passage improvement, in-stream habitat, acquisition, riparian vegetation restoration, and in-stream diversions (<http://www.governor.wa.gov/gsro/monitoring.htm>). The WRIA 8 Technical Committee will work with the SRFB to obtain information on the effectiveness of those types of projects and determine its relevance and usefulness in WRIA 8.

The WRIA 8 Technical Committee recommended focusing project effectiveness monitoring on:

- Instream habitat enhancement (based on placement of structures such as Large woody debris, boulders, other hydraulic or cover elements);
- Vegetation restoration/ invasive species vegetation control (along all shoreline types);
- Bank armoring removal (Including bioengineered bank stabilization and erosion control);
- Shoreline restoration (specifically lacustrine and marine nearshore beach augmentation or bank restoration);
- Over-water structures (including dock modifications)

- Floodplain reconnection (Including river levee setbacks and specifically the effectiveness of off-channel habitats);
- Restoration projects to reduce fine sediment reduction in spawning streams
- Water quality enhancement (e.g., effectiveness of project or outreach BMPs, stormwater retrofits for quality control, temperature and dissolved oxygen control, and other treatment targeting reduction in metals, nutrients, and other constituents);
- Management of exotic species of flora and fauna

These projects have been identified by the Technical Committee as having less certain outcomes, either because accepted and tested standard engineering designs are not yet developed or because of greater uncertainty of implementation or direct effectiveness in the urban environment. Upland projects, such as low impact development projects for stormwater, may also be included for project specific monitoring. For projects that have more reliable outcomes, performance may be evaluated based on EDT modeling, using the model's project effectiveness library, or through the design criteria and as-built information. WRIA 8 will utilize specific protocols and monitoring designs from the SRFB project monitoring program where applicable. Monitoring protocols and statistical designs will have to be developed for project types not covered by the SRFB program, after the projects to be implemented have been identified.

In addition to the direct effectiveness monitoring recommendation for lakeshore habitat, juvenile Chinook use of lakeshore habitat has been identified as a key uncertainty in the scientific framework. The Steering Committee recommends that evaluation of juvenile use of habitat and modified habitat be conducted annually. The current efforts for lake habitat utilization, using snorkel surveys, have been conducted by the US Fish and Wildlife Service and the City of Seattle. It is recommended that the snorkel surveys be conducted for lakeshore restoration project using the established protocols and be reported on an annual basis to coordinate with the cumulative monitoring program.

Outreach

Educational programs also need to be monitored to determine if the programs cause a change in the perceptions of the participants and if that changed perception results in the participants making voluntary habitat improvements on their properties. There are already a number of programs in WRIA 8, such as the Natural Yard Care Program, that conduct evaluations of the impact of their programs in changing the behaviors of individuals. The WRIA 8 Outreach Committee will utilize regional and local programs such as these whenever possible to evaluate the educational program's ability to change habitat degrading behaviors. In addition, the status and trends of the public's general awareness and perception of salmon habitat needs and salmon recovery efforts will be monitored through a professional survey every five years in conjunction with the major plan reviews. Specific hypotheses and statistical design for the Outreach monitoring plan have not yet been developed.

Land Use

Land use actions will need to be monitored for their effectiveness in protecting riparian vegetation, reducing stormwater runoff, and protecting upland forests. There is currently great diversity of land-use protections among the jurisdictions within the watershed and variability in how regulations are implemented and enforced. Careful monitoring design and protocols will be needed to develop a cross-jurisdictional evaluation of regulatory protections' effectiveness. Specific hypotheses to be tested and the statistical design of the analyses have not yet been developed. Because local jurisdictions can choose among a menu of options to achieve the

desired landscape conditions, the Technical Committee recommends that the cumulative effect of the various options for riparian vegetation and upland forest protection be evaluated through sub-meter multi-spectral image analysis for vegetation and impervious surfaces.

Direct effectiveness monitoring for Stormwater management effectiveness is usually conducted through research into the effectiveness of individual best management practices (BMPs). Much of this work is already being conducted on a collaborative basis through the University of Washington. WRIA 8 will not generally engage at that level of effectiveness monitoring, but will evaluate the effectiveness of all the stormwater management techniques and land-use actions in addressing changes to peak flows, low flows, and stream flashiness using data from flow gauging stations corrected for rainfall conditions. The flow information will be compared to WRIA 8 flow model results, as published in the Salmon and Steelhead Habitat Limiting Factors Report for the Cedar- Sammamish Basin (Water Resource Inventory Area 8).

The areas with the best and least success in protecting forest cover, riparian forests, and natural flow characteristics can be evaluated against the suite of implementation options used and development pressures on each area. Both the land-use and stormwater monitoring direct effectiveness monitoring elements are more similar to cumulative monitoring efforts, due to the complexity of conducting effectiveness monitoring for the full range of management options available to each jurisdiction.

Direct effectiveness monitoring for projects, outreach, and land-use will be conducted annually, but results will be analyzed and reported according to the statistical design for the project. For example, it is anticipated that some projects, such as fish passage improvement projects, will produce results within one year. Others, such as levee setbacks or large woody debris projects may be monitored for up to 10 years with monitoring conducted annually based on project objectives and stated performance criteria appropriate for measuring at different times (for example, large, woody debris placed in the first year of a project can be monitored with respect to stability and movement depending on flows, but it may take longer for aquatic habitats to fully form (Beechie et al. 2003). The WRIA 8 Technical Committee will work with WDFW to coordinate permit monitoring requirements with WRIA direct effectiveness monitoring designs and protocols.

Cumulative Effectiveness Monitoring

Habitat Monitoring

Cumulative effectiveness monitoring will be used to evaluate how multiple actions are affecting habitat condition and fish populations, and what kinds of overall adjustments in conservation priorities may be needed. This monitoring integrates the corrective actions of the Plan with all the other actions in the watershed that may influence progress toward the desired habitat and salmon population conditions. At this time, the Steering Committee has not set specific interim goals for habitat or Chinook condition. It is anticipated that the Steering Committee/Oversight Committee will work to establish “targets” of habitat condition or population condition in 2005-2006. These interim goals will allow decision-makers to determine whether specific areas (spawning streams, migratory areas) are improving as anticipated and whether the cumulative actions are achieving the anticipated rate of improvements. Having interim goals assists with developing monitoring plans, clarifies critical decision points, and assists with communicating progress to the public.

The scientific basis for the Plan utilized existing multi-spectral and geographic information systems (GIS) analysis to determine large-scale landscape and local scale habitat conditions

that are known to influence ecological processes that affect aquatic habitat structure and function within the watershed (see chapter 3). This effort utilized LandSat technology (30 meter resolution), which is very useful and inexpensive for cumulative effectiveness analysis and monitoring over long time periods (potentially back to the 1970's) and larger geographic areas (individual subbasins) but which limited small scale analyses. The Technical Committee recommends sub-meter level resolution multi-spectral analyses be utilized to determine riparian conditions of total forest cover, forest maturity, riparian width, impervious area within riparian, road crossings, along streams, lakes, and marine shorelines in order to develop an Index of Riparian Integrity for EDT reaches, itself to be used for riparian monitoring. The sub-meter resolution would provide the ability to detect changes in areas smaller than 30 meters, which may be necessary, especially in developed areas where land cover is extremely fragmented. This information will be used for both direct effectiveness monitoring at the jurisdiction level for land-use action effectiveness and for cumulative effectiveness monitoring at the basin scale. Multi-spectral analyses should be conducted on a five year basis to correlate with major reviews of the WRIA Plan and to provide information to support local Growth Management Plan reviews and other local land-use plan updates.

To detect the status and future trends in aquatic condition, it is recommended that WRIA 8 implement the recommendations of the Governor's Salmon Recovery Team to implement an EPA Environmental Monitoring and Assessment Program (EMAP) reconnaissance of the watershed, linked to previous stream assessment monitoring information and watershed information needs. The EMAP protocol includes diverse indicators of aquatic health, including habitat, basic water quality, macroinvertebrates, algae, and multi-species fish assemblages. EMAP protocols employ a randomized approach to sampling locations often linked with critical annual monitoring stations. The EMAP strategy would need to be employed in a way answer to the adaptive management questions and hypotheses for WRIA 8, which may involve slight modifications to the standard sampling plan for general evaluation of trends in watershed conditions. Using EMAP would have multiple benefits, such as 1) allowing WRIA 8 information to be "rolled up" into regional, state, and federal evaluations, 2) avoiding the necessity of monitoring every mile of stream within the watershed to determine the watershed condition, 3) providing a statistically valid method of evaluating trends in a highly variable environment, and 4) allowing the use of new risk assessment analytical tools for stressors to biological communities. This monitoring would allow comparisons of actions between watersheds, provide reliable information about habitat trends over time, and would provide habitat information on all types and sizes of stream within the watershed. The EMAP program would provide information necessary for a multi-species approach to habitat improvement, rather than focus on only Chinook streams, without increasing monitoring costs. Over time, EMAP monitoring would allow the evaluation of some of the key uncertainties in the stream habitat and biological data used in the EDT model and provide opportunities to continue to improve the capability of the model to accurately prioritize actions that will provide the greatest benefits. The information on habitat change in the watershed will also be needed when interpreting fish population changes. EMAP assessments should occur on an annual basis or utilized for a trend assessment every five years to coordinate with the major Plan review periods.

Marine shorelines are critical habitat for salmonids from many watersheds, so evaluating habitat conditions within WRIA nearshore marine habitats is considered critical for the both the WRIA and Environmentally Significant Unit conservation efforts. This assessment should include distance, type and location of bank armoring; number, location, and area of over-water structures; location and area of gravel recruitment sites; condition, area, and location of stream deltas and wetlands. This monitoring should be coordinated with the Puget Sound Nearshore Program, PSAMP, and other Puget Sound marine shoreline recovery efforts.

Stream flow is a critical element for salmon recovery efforts. Flow gauging is currently conducted by local jurisdictions and USGS in rivers and streams across the watershed. A cursory review of flow gauging stations by the Technical Committee indicated that additional flow gauging stations would not likely be needed. However, a final review will be needed when developing the statistical design for the monitoring program. It is critical, however, that local jurisdictions or USGS maintain existing permanent flow gauging stations. Specific protocols and data management tools for sharing data from these gauges are needed. Rain gauges are also maintained by local governments and additional gauges are not likely to be needed. Flow and rain data will need to be collected and analyzed according to standard protocols on an annual basis. Annual flow reports should be prepared with a trend assessment and model comparison every five years to coordinate with the Conservation Plan major review periods. The cumulative monitoring information will be used to determine trends in basin flow conditions as compared to the baseline established in the WRIA 8 flow report included in the Salmon and Steelhead Habitat Limiting Factors Report for the Cedar- Sammamish Basin (Water Resource Inventory Area 8). The proposed Technical and Oversight Committees will use cumulative monitoring information by basin to determine whether additional investigations of land-use actions for stormwater management, groundwater recharge protection, and water withdrawals are needed.

Chinook Monitoring

The Steering Committee strongly endorses monitoring Chinook response to habitat actions. The Technical Committee has also stated that monitoring various life stages of Chinook is imperative to reduce some of the key uncertainties in the scientific foundation of the Plan. It is necessary to monitor more than one Chinook life history stage to determine whether freshwater habitat improvements from plan actions are improving the health of Chinook populations and to isolate influences within the watershed. The primary life stages of Chinook to be monitored are spawners, juvenile migrants from streams, juvenile migrants through the lakes and migratory corridors, and smolt use of nearshore marine areas. Monitoring population responses and setting population de-listing criteria is a state and federal responsibility. However, the Technical Committee recommends working collaboratively with these entities so that local monitoring information can “roll up” to larger monitoring and evaluation programs.

Weekly Chinook spawner surveys are currently conducted by WDFW, The Muckleshoot Tribe, and local jurisdictions. The surveys are considered critical, but currently do not always span the complete salmon migration season, nor survey all salmon bearing streams. It is recommended that professional surveys be conducted based on WDFW protocols for all core and satellite streams for the full migratory season. Spawning surveys should be designed to include the full fall anadromous spawning period, so all species of fall spawning salmon are included. However, additional sampling would be needed to fully evaluate coho and steelhead population conditions. It is also recommended that scale samples be taken to identify the ages of returning Chinook. Professional spawner survey information and juvenile outmigrants from streams will be used to evaluate trends in the egg to outmigrant survival and distribution of spawning populations. While spawner surveys provide information on the abundance of Chinook, it is a synthesis of all freshwater and saltwater factors influencing the population. Using a combination of spawner surveys and smolt trapping effectively eliminates the influence of ocean conditions, harvest, and other outside influences on the Chinook population. Professional spawner survey information is currently augmented by spot observations by trained volunteers through the WRIA 8 Salmon Watcher Program (<http://dnr.metrokc.gov/wlr/waterres/salmon/index.htm>). It is recommended that this volunteer monitoring program be continued. Spot observations are useful to determine the incidence of spawner use of satellite and episodic basins. Annual spawning survey reports will need to be

compiled by basin with comprehensive reviews by population every five years in time for the major Plan review. The five year reviews will provide current information by population, but Chinook population response information will take the full ten year plan implementation period and beyond.

Trapping Chinook migrating from the Cedar River and Bear Creek ("smolt trapping") is considered critical for evaluating core spawning areas for the Cedar River Chinook population and the North Lake Washington Chinook population. These trapping locations are also linked with monitoring survival through migratory areas. If it is determined that there are only two Chinook populations or the Issaquah Hatchery Chinook population becomes considered essential for recovery by NOAA Fisheries, it is recommended that Chinook migrating from Issaquah Creek be monitored. It is also desired to monitor the migrating Chinook from Kelsey Creek, a satellite basin for the North Lake Washington Chinook population. Juvenile outmigrant surveys should be designed to include the full migration period, so all species of fall spawning salmon are intercepted. This information will be used in conjunction with spawning survey information to determine the trends of Chinook production in a satellite stream and the capacity of urbanized streams to contribute to salmon recovery. Smolt trapping information will be collected annually and used in conjunction with spawning survey information to evaluate egg to outmigrant survival, as well as trends in juvenile production, spawner to outmigrant production, and the proportions of river rearing and lake rearing juveniles. While more comprehensive reviews of smolt trapping data can be conducted every five years in conjunction with the major plan reviews, as mentioned previously, longer periods of record are necessary for statistical analysis of population parameters.

Another critical element to monitor is Chinook survival in the lakes and migratory areas. Passive Integrated Transponder (PIT) tags are one technique used to evaluate juvenile migration routes and timing in Lake Washington, the Sammamish River, and the Ship Canal. They can also be used to evaluate survival rates through various migratory areas of the watershed, as long as additional samples are collected beyond the locks to evaluate sampling efficiency. This information is considered critical for determining whether actions are improving survival of lake rearing and migrating juveniles, isolating spawning habitat impacts from rearing and migratory impacts, and reducing key uncertainties in the scientific framework. PIT tags are implanted in outmigrating juvenile Chinook, which is most efficiently done in conjunction with smolt trapping. The PIT tagging work that has been done previously has been funded and managed by the Army Corp of Engineers (ACOE) and the City of Seattle (http://www.nws.usace.army.mil/publicmenu/DOCUMENTS/PitTagReport_2002data.pdf). This work has been a combination of intensive monitoring, which is necessary for determining migratory routes and survival, and less intensive monitoring, which primarily evaluates timing from the streams to the locks. PIT tag results should be summarized annually, with trend assessment conducted in concert with the major five year plan review.

Steering Committee recommends continuing snorkel surveys in Lake Washington to determine abundance of fry in different index reaches of the lake. This information will be used to determine trends in habitat use, migration trajectories, juvenile abundance, and lake migration timing. Effectiveness monitoring efforts for lake habitat modifications could be used to offset or augment index surveys (Tabor, 2002).

Another key uncertainty in the scientific framework is changes in lake food web dynamics. There have been numerous efforts to evaluate components of the Lake Washington food web dynamics through the Lake Washington Sockeye Studies, University of Washington research, and WDFW warm water fish studies. A warm water species survey of Lake Washington would

be invaluable in determining population status of resident native and exotic species. This type of full lake survey should be done on a periodic basis to evaluate trends in predator and prey species as habitat conditions are changed. The frequency and design of this trend assessment has not yet been established.

Validation Monitoring

Identifying trends in population parameters for use in delisting Chinook from the Endangered Species Act is considered by the Technical Committee to be beyond the scope of WRIA 8. However, the cumulative monitoring efforts should be accomplished in a manner that would assist other entities in validation monitoring. A method for coordinating monitoring efforts at the Puget Sound scale should be developed. It is possible that the Shared Strategy for Puget Sound may be able to assist with this function.

Coordination of Monitoring Efforts

Given the diverse group of entities monitoring elements of habitat and salmon recovery, it will be imperative to develop a plan to coordinate actions across jurisdictions. It will require both political and technical communications to determine who is the appropriate entity to conduct protocol development and training, field work and equipment maintenance, quality assurance and control, data management and analyses, coordination and scheduling, and reporting. Table 6-1 summarizes recommendations for WRIA 8 monitoring and entities currently or potentially involved in these monitoring activities. The Steering Committee recommends working towards a comprehensive data management system that would be accessible by all local jurisdictions and citizens. However, it is recognized that the monitoring programs need to be more fully developed and stabilized before this recommendation can be implemented.

Draft Interim Goals

In order for monitoring to be most useful for adaptive management, the information has to be linked to management decisions. As identified in chapter 3, the Technical Team has suggested a number of interim goals based on the Viable Salmon Population (VSP) guidance from the National Ocean and Atmospheric Administration (NOAA) Fisheries formerly known as National Marine Fisheries Service (McElhany et al, June 2000). NOAA Fisheries has identified four parameters that will be used to evaluate population viability status. These are diversity, abundance, productivity, and distribution. During the major review periods, the Technical Committee will review the information collected through the cumulative monitoring program and compare results to the interim goals to see whether the habitat improvements are having the anticipated effects and are occurring at the desired rate of improvement. The proposed Oversight Body will review this information from the Technical Committee to determine whether an alteration to the focus or funding of the Plan is warranted.

Next Steps

Once the Plan is ratified, the proposed Oversight and Technical Committees will need to approach other entities involved in monitoring, such as the Shared Strategy, federal and state agencies, local jurisdictions, SRFB, and ACOE to secure their commitment to perform monitoring activities. A strategy to determine responsibilities for various elements of monitoring habitat and salmon recovery will need to be developed for both technical and policy issues (See table 6-1).

A stable, consistent funding mechanism will need to be identified and approved for the monitoring program.

Once the plan is ratified, the Technical Committee will need to develop specific hypotheses to be tested and design statistically valid monitoring plans for each monitoring element included in the Plan. They will also need to develop common protocols, training, equipment, database, data management, data analysis, and data sharing techniques across jurisdictions. These issues are currently substantial barriers to a WRIA monitoring program, especially if conducted through individual jurisdiction efforts. If the monitoring is to be conducted by a combination of individual jurisdiction efforts and outside entities, the difficulties will be increased. This effort will require a focused work program and local jurisdiction commitment to developing a regional monitoring agreement and support structure once the Plan is ratified.

There is no common database available in which to compile WRIA 8 monitoring data. Any interjurisdictional sharing of monitoring data either within the WRIA or across WRIsAs will require additional technical resources to define the needs and costs of database development and data management.

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